PATENT SPECIFICATION 749,864

Inventors:—JAMES JOHN STEWART SMITH and LEONARD PERCY BAGGE.

Date of filing Complete Specification : Oct. 28, 1954.

Application Date : Oct. 5, 1953. No. 27287/53.

Complete Specification Published : June 6, 1956.

Index at Acceptance :—Class 7(2), B1B(6 : 9), B1D(6 : 10), B1G4J.

COMPLETE SPECIFICATION.

Improvements in or relating to the Balancing and Charging of Internal Combustion Engines.

We, SIR W. G. ARMSTRONG WHITWORTH & COMPANY (ENGINEERS) LIMITED, of 121 Queen Victoria Street, London, E.C.4, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the balancing and charging of internal combustion engines, and the object of the invention is to use charging means to provide an internal combustion engine with improved balance.

The present invention consists in an internal combustion engine in which the or each working cylinder has a poppet type valve in the cylinder head, and inlet ports in the wall of the cylinder, the or each working piston being provided with balancing means which is arranged diametrically opposite to the working piston with respect to the crankshaft and comprises an auxiliary piston which reciprocates in the opposite direction to the working piston and works in an auxiliary cylinder of which the end remote from the crankshaft is arranged and controlled so that fresh charge is compressed therein before being passed to the corresponding working cylinder.

The invention further consists in an internal combustion engine in which the or each working piston is provided with balancing means which is arranged diametrically opposite to the working piston with respect to the crankshaft and comprises an auxiliary piston which reciprocates in the opposite direction to the working piston and works in an auxiliary cylinder of which the end remote from the crankshaft is arranged and controlled so that fresh charge is compressed therein before being passed to the corresponding working cylinder, and in which entry and exit of air to and from the crank case is controlled and the working and auxiliary pistons operate to induce air into said crank case as they move away from each other, and to compress the said air in a first stage therein as they move towards one another, preparatory to compression of the air in a second stage in the end of the cylinder of the auxiliary piston remote from the crankshaft as the said piston moves away from the crankshaft.

In one form of construction the crank case is provided with non-return valve means from the atmosphere, and non-return valve means between the crank case and the auxiliary cylinder, while non-return valve means is provided between the auxiliary cylinder and the combustion chamber of the working piston.

The drawings accompanying the Provisional Specification show, by way of example only, two embodiments of the invention in which:—

Figure 1 is a part longitudinal section through the cylinder and crank case of an internal combustion engine;

Figure 2 is a transverse section through the same cylinder; and

Figure 3 is a transverse section taken through the cylinder of a further embodiment.

Referring to the embodiment shown in Figures 1 and 2 the working piston 1 is fastened to the connecting rod 2 by means of gudgeon pin 3 in the normal manner. The engine is of the two-stroke cycle type and has an air capacity chamber 4 arranged around the cylinder walls 5 in which inlet ports 6 are provided to give access to the cylinder proper, there being a poppet type exhaust valve in the cylinder head as shown.

The large end 7 of the connecting rod 2

[*Price 3s. 0d.*]

Price 25p

is split and bolted together around the crank pin 8 in the usual way. Crank webs 9 are provided at each end of the crank pin 8 and eccentrics 10 are machined on the outer faces of the webs. A forked strap or connecting link 11 is fitted on each of these eccentrics, on the other end of each an auxiliary piston 12 is attached by means of the gudgeon pin 13.

It will be seen that the crank pin of the working piston 1 and the eccentrics of the piston 12 are opposed to one another with the result that their revolving forces and inertia forces are opposed to one another and thus by suitable arrangement of the weights of the moving parts, the engine can be completely balanced or at least can be arranged to give only very slight out of balance forces. To achieve complete balance the ratio of the connecting rod length to the crank radius in both instances requires to be the same with suitable adjustments of the weights of the moving parts.

Inlet and outlet ports 14 and 15 controlled by non-return valves 16 and 17 respectively allow of the entry of air by way of the air filter 18 to the cylinder of the piston 12 during its movement towards the crankshaft, while the air is forced out of the cylinder by way of the non-return valve 17 and the air passage 19 to the chamber 4 when the piston moves away from the crankshaft.

In the modified embodiment shown in Figure 3 the crank case is closed and is provided with an automatic non-return valve or valves so that the crank case becomes the first stage compressor of a two-stage compressor unit.

A non-return valve 20 is fitted to the crank case door 21 which allows of the entry of air to the crank case by way of the air filter 18 as the working piston 1 and the piston 12 move away from each other. During this period of the cycle of operations of the engine the air in the air cylinder is being compressed and the automatic non-return valve 16 between the crank case, which is the first stage compressor, and the air cylinder, which is the second stage compressor, is closed. During the same period the valve 17 is open and allows the air from the air cylinder to pass by way of the air passage 19 to the air capacity chamber 4, from whence it is transferred to the working cylinder when the ports 6 are uncovered by the working piston.

The air in the crank case is compressed by the two pistons as they move towards each other. The smaller the capacity of the crank case relative to the volume displaced by the pistons the higher will be the pressure of the air during the first stage of compression.

Owing to the double stage of compression the capacity of the air cylinder is smaller than when the air cylinder is used alone as in the previously described embodiment.

Figure 3 shows a single cylinder two-stroke unit, but, provided the individual crank cases, or first stage air compressors, are isolated from one another, the invention is applicable to multi-cylinder two-stroke cycle engines.

The invention is also applicable to four-stroke cycle engines having single or multi-cylinders, and in such applications consideration must be given to the fact that each piston delivers air to the air chest twice per cycle, i.e. once per revolution of the crankshaft.

The invention is not limited to the forms of construction hereinbefore described as details for carrying the invention into effect may be varied without departing from the scope of the invention claimed.

What we claim is:—

1. Internal combustion engine in which the or each working cylinder has a poppet type valve in the cylinder head, and inlet ports in the wall of the cylinder, the or each working piston being provided with balancing means which is arranged diametrically opposite to the working piston with respect to the crankshaft and comprises an auxiliary piston which reciprocates in the opposite direction to the working piston and works in an auxiliary cylinder of which the end remote from the crankshaft is arranged and controlled so that fresh charge is compressed therein before being passed to the corresponding working cylinder.

2. Internal combustion engine in which the or each working piston is provided with balancing means which is arranged diametrically opposite to the working piston with respect to the crankshaft and comprises an auxiliary piston which reciprocates in the opposite direction to the working piston and works in an auxiliary cylinder of which the end remote from the crankshaft is arranged and controlled so that fresh charge is compressed therein before being passed to the corresponding working cylinder, and in which entry and exit of air to and from the crank case is controlled and the working and auxiliary pistons operate to induce air into said crank case as they move away from each other, and to compress the said air in a first stage therein as they move towards one another, preparatory to compression of the air in a second stage in the end of the cylinder of the auxiliary piston remote from the crankshaft as the said piston moves away from the crankshaft.

3. Internal combustion engine as claimed in Claim 2 in which the crank case is provided with non-return inlet valve means from the atmosphere, and non-return valve means

between the crank case and the auxiliary cylinder, while non-return valve means is provided between the auxiliary cylinder and the combustion chamber of the working piston.

4. Internal combustion engine substantially as hereinbefore described with reference to and as shown in Figures 1 and 2 of the drawings accompanying the Provisional Specification.

5. Internal combustion engine substantially as hereinbefore described with reference to and as shown in Figure 3 of the drawings accompanying the Provisional Specification.

MARKS & CLERK.

PROVISIONAL SPECIFICATION.

Improvements in or relating to the Balancing and Charging of Internal Combustion Engines.

We, SIR W. G. ARMSTRONG WHITWORTH & COMPANY (ENGINEERS) LIMITED, of 121 Queen Victoria Street, London, E.C.4, a British Company, do hereby declare this invention to be described in the following statement:—

This invention relates to the balancing of reciprocating engines, and the object of the invention is to provide an internal combustion engine with improved balance.

Heretofore it has been proposed to provide a piston in an internal combustion engine with a mass on the diametrically opposite side of the crank shaft moving in opposite directions to the piston to balance the same. It has also been proposed to provide a pump of the piston type constituting the said mass and acting to compress air for scavenging purposes in two-stroke cycle internal combustion engines.

The present invention consists in an internal combustion engine of the kind in which the or each working piston is provided with a mass on the diametrically opposite side of the crank shaft moving in opposite directions to said working piston to balance the same, characterised in that said mass is constituted by an auxiliary piston working in a cylinder of which the end remote from the crank shaft is arranged and controlled so that each charge of air for the combustion chamber is compressed therein.

The invention further consists in an internal combustion engine as set forth in the preceding paragraph in which the entry and exit of air to and from the crank case is controlled and the working and auxiliary pistons operate to induce air into said crank case as they move away from each other, and to compress the said air in a first stage therein as they move towards one another, preparatory to compression of the air in a second stage in the end of the cylinder of the auxiliary piston remote from the crankshaft as the said piston moves away from the crankshaft.

In one form of construction the crank case is provided with non-return inlet valve means from the atmosphere, non-return valve means between the same and the auxiliary cylinder, while non-return valve means is provided between the auxiliary cylinder and the combustion chamber of the working piston.

The accompanying drawings show, by way of example only, two embodiments of the invention in which:—

Figure 1 is a part longitudinal section through the cylinder and crank case of an internal combustion engine;

Figure 2 is a transverse section through the same cylinder; and

Figure 3 is a transverse section taken through the cylinder of a further embodiment.

Referring to the embodiments shown in Figures 1 and 2 the working piston 1 is fastened to the connecting rod 2 by means of gudgeon pin 3 in the normal manner. The engine is of the two-stroke cycle type and has an air capacity chamber 4 arranged around the cylinder walls 5 in which ports 6 are provided to give access to the cylinder proper.

The large end 7 of the connecting rod 2 is split and bolted to the crank pin 8 in the usual way. Crank webs 9 are provided at each end of the crank pin 8 on which are machined the eccentrics 10. A forked strap or connecting link 11 is fitted on each of these eccentrics, on the other end of each a reciprocating air piston 12 is attached by means of a gudgeon pin 13.

It will be seen that the crank pin of the working piston 1 and the eccentrics of the air piston 12 are opposed to one another with the result that their revolving forces and inertia forces are opposed to one another and thus by suitable arrangement of the weights of the moving parts, the engine can be completely balanced or at least can be arranged to give only very slight out of balance forces. To achieve complete balance the ratio of the connecting rod length to the crank radius in both instances requires to be the same with suitable adjustments of the weights of the moving parts.

Inlet and outlet ports 14 and 15 controlled by non-return valves 16 and 17 respectively allow of the entry of air by way of the air filter 18 to the cylinder of the air piston 12 during its movement towards the crank shaft, while the air is forced out of the cylinder by way of the non-return valve 17 and the air passage 19 to the chamber 4 when the piston moves away from the crankshaft.

In the embodiment shown in Figure 3 the crank case is closed and is provided with automatic non-return valve or valves so that the case becomes the first stage compressor of a two-stage compressor unit.

A non-return valve 20 is fitted to the crank case door 21 which allows of the entry of air to the crank case by way of the air filter 18 as the working piston 1 and the air piston 12 move away from each other. During this period of the cycle of operations of the engine the air in the air cylinder is being compressed and the automatic non-return valve 16 between the crank case, which is the first stage compressor, and the air cylinder, which is the second stage compressor, is closed. During the same period the valve 17 is open and allows the air from the air cylinder to pass by way of the air passage 19 to the air capacity chamber 4, from when it is transferred to the working cylinder when the ports 6 are uncovered by the working piston.

The air in the crank case is compressed by the two pistons as they move towards each other. The smaller the capacity of the crank case relative to the volume displaced by the pistons the higher will be the pressure of the air during the first stage of compression.

Owing to the double stage of compression the capacity of the air cylinder is smaller than when the air cylinder is used alone as in the previously described embodiment.

Figure 3 shows a single cylinder two-stroke unit, but, provided the individual crank cases, or first stage air compressors, are isolated from one another, the invention is applicable to multi-cylinder two-stroke cycle engines.

The invention is also applicable to four-stroke cycle engines having single or multi-cylinders, and in such applications consideration must be given to the fact that each piston delivers air to the air chest twice per cycle, i.e. once per revolution of the crankshaft.

The invention is not limited to the forms of construction hereinbefore described as details for carrying the invention into effect may be varied without departing from the scope of the invention.

MARKS & CLERK.

Abingdon: Printed for Her Majesty's Stationery Office, by Burgess & Son (Abingdon), Ltd.—1956.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2,
from which copies may be obtained.

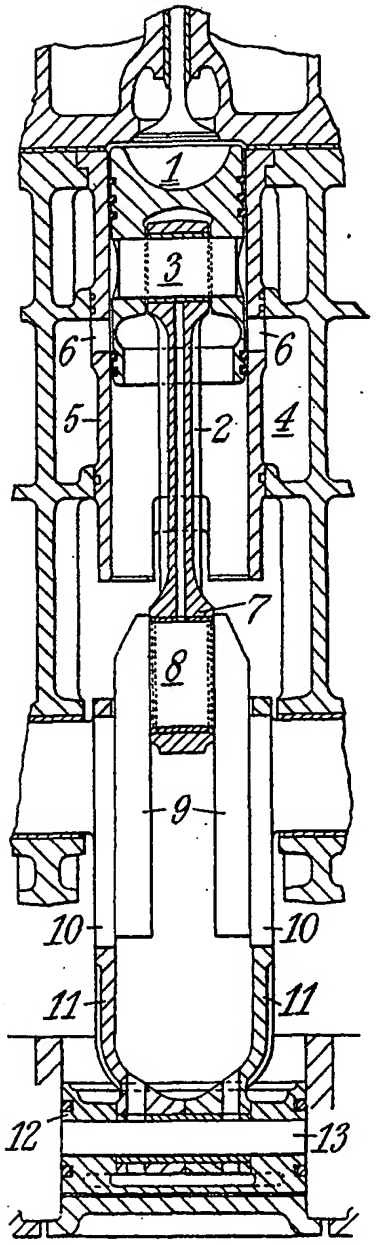


Fig. 1.

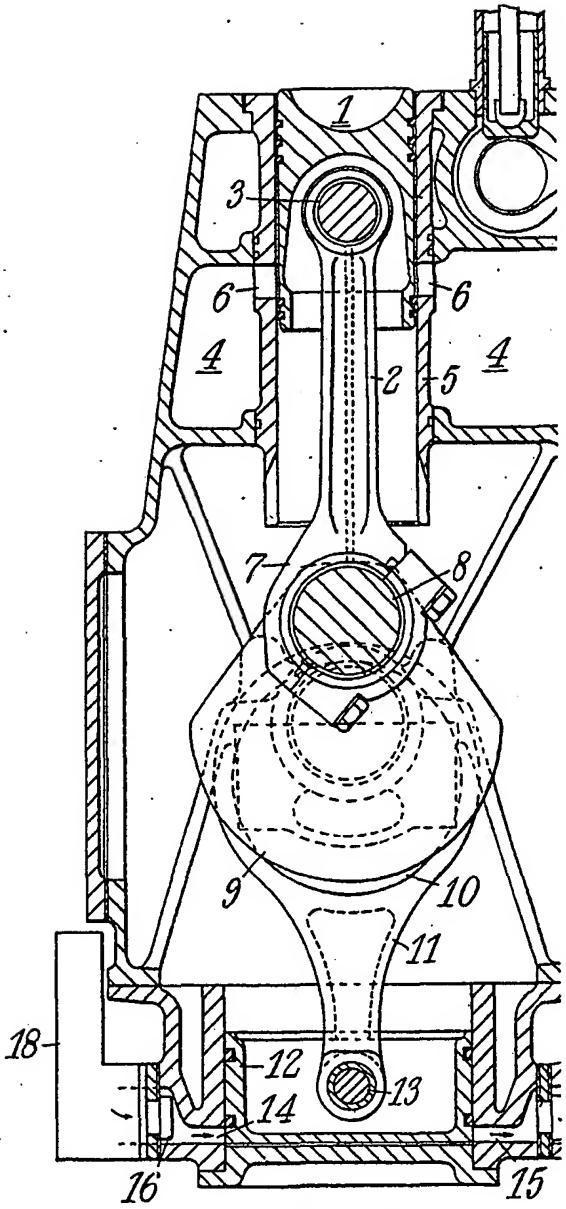
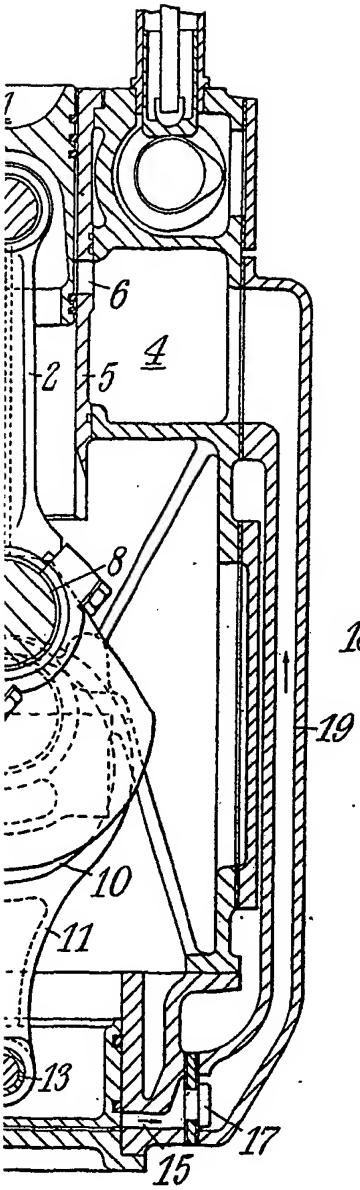


Fig. 2.

749,864 PROVISIONAL SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.



2.

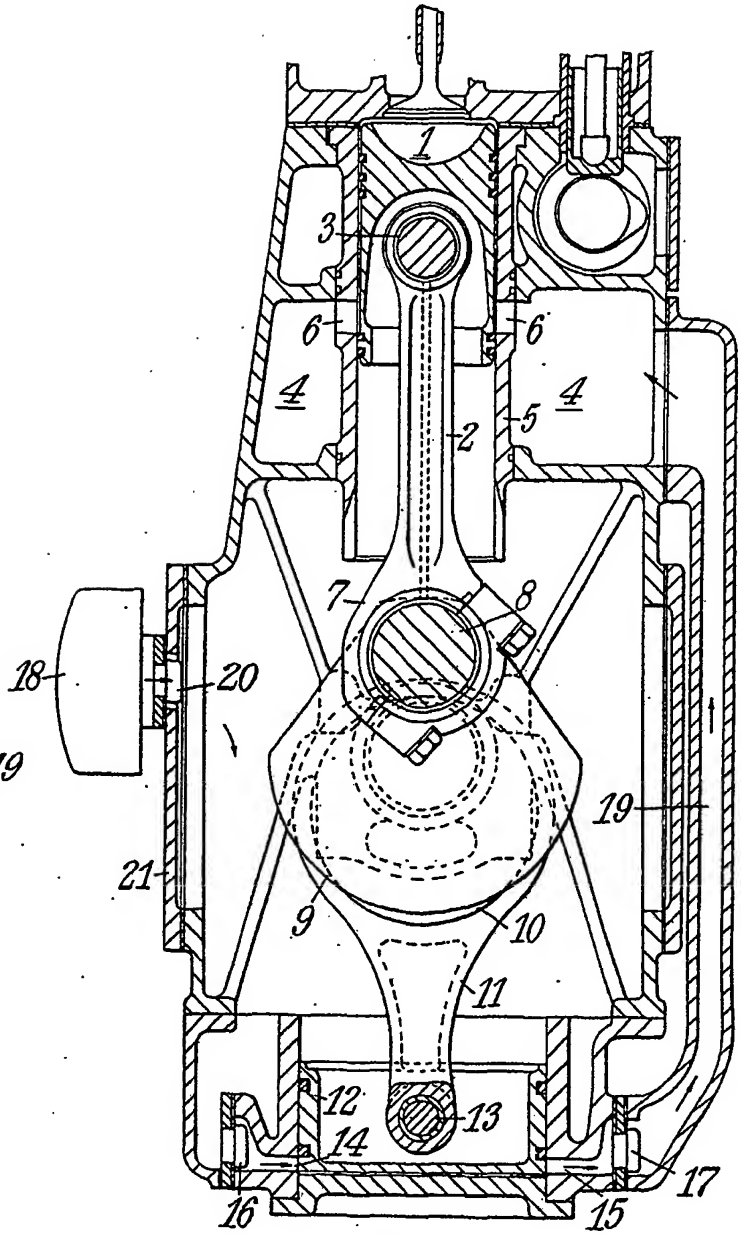


Fig. 3.

749,864 PROVISIONAL SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

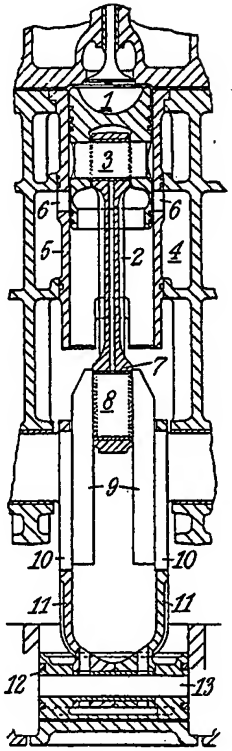


Fig. 1.

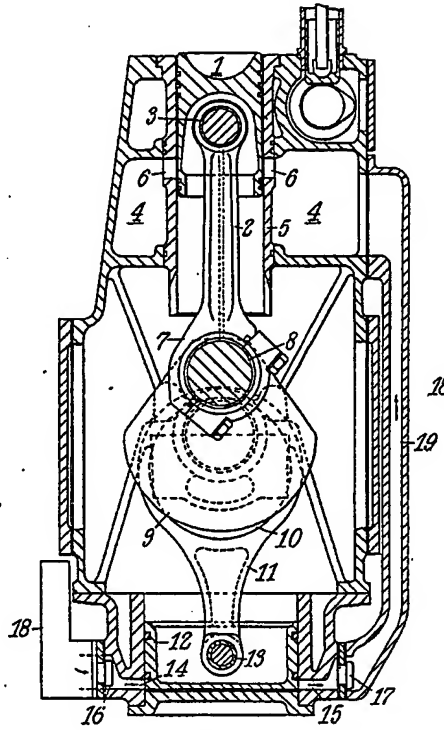


Fig. 2.

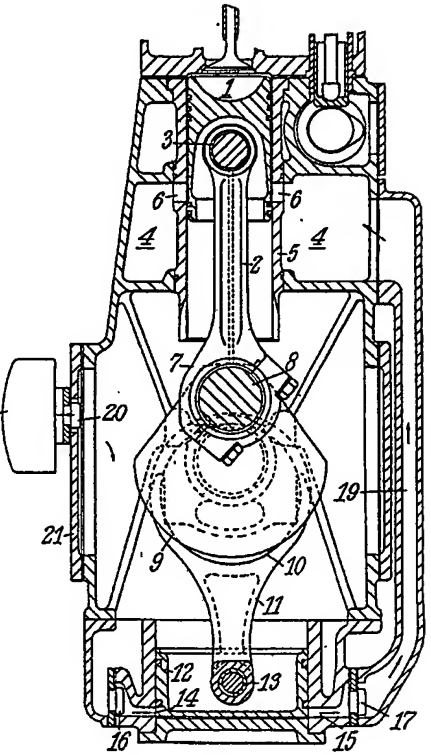


Fig. 3.

TRANSLATION OF JAPANESE PATENT
PUBLICATION NO. JP57-146938
(Item #1 of the list 2)
Publication Date: 1982.9.10
Applicant: Triumph Motorcycles

1) A reciprocating engine having at least one piston (10); a connecting rod (12) that is connected to the piston at one end; a crank shaft (14) that is assembled to another end of the connecting rod; a balancing link (17) that is configured as a balance weight, this balancing link being pivotably mounted to the crank shaft by one end of the balancing link; guide means (19), (20), (21) being structured as a guide link (19) that is pivotably mounted by one end (21) to a fixing point, this guide means causing the other end of the balancing link to be forcibly moved, in a direction that is opposite to the piston, so as to perform a substantially linear stroke that is perpendicular to an axis of the crank shaft; this reciprocating engine being characterized in that

the other end (20) of the guide link (19) is assembled to a point which is effectively in agreement with the center of impact (strike) of the balancing link (17), this center of impact being limited by movement of the balancing link (17) from the center of gravity (G) of the balancing link (17), this movement being a distance equal to the square of a polar radius of rotation of the balancing link (17) that is divided by a distance between the center of gravity (G) of the balancing link and a connection point (D) connecting to the crank shaft (14), and as the result of this, when the engine is in operation, the balancing link (17) effectively balances all inertial forces of the piston (10) and the connecting rod (12).